MECHANICS' MAGAZINE,

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VOLUME III.] FOR THE WEEK ENDING APRIL 26, 1834. [NUMBER 4.

Other things may be seized by might, or purchased with money: but knowledge is to be gained only by study, and study to be prosecuted only in retirement.

HANCOCK'S WEDGE WHEELS.

Fig. 1.

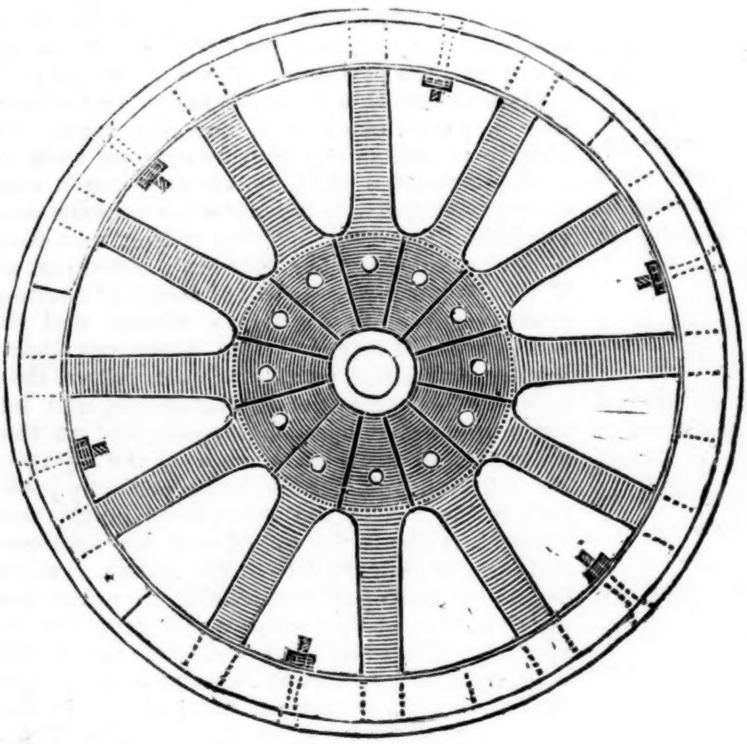
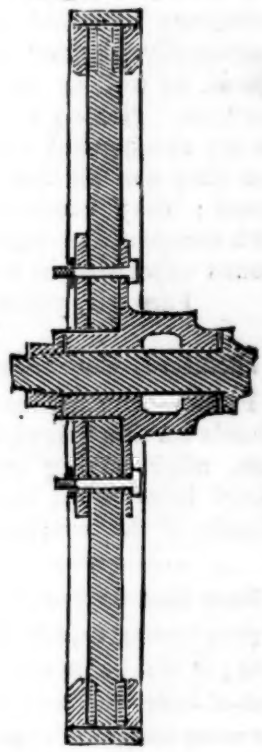


Fig. 2.



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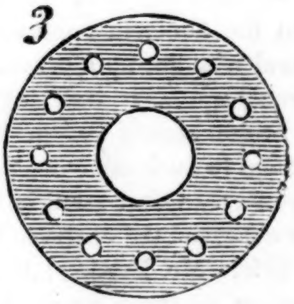

Hancock's Wedge Wheels. [From the London Mechanics' Magazine.

SIR,—I forward you a sketch and description of the wedge wheels which I have adopted for my steam carriages, having found those of other constructions insufficient for the purpose. Being desirous of employing vertical wheels, and knowing that those on the common plan could not stand in this position, I determined on trying a pair constructed in the manner I am about to describe, and which description I am induced to send you, from a belief they may be found useful generally, and more particularly to those who are engaged in similar pursuits with myself.

Fig. 1 is a front view of a wheel, with the front bindplate removed, to show the meeting of the wedged spokes, which are of straight grained, well seasoned ash, tenoned into the felloes as in common wheels, but the nave ends are very accurately fitted to each other in radial joints, butting against the iron box of the axle, and forming around it, to the circumference of the bind-plate (shown by a dotted circle), a solid connection of timber.

Fig. 2 is a horizontal central section of the above. The tire is secured by a bolt and nut, or rivets, through each felloe, the heads being countersunk, so as to stand flush with the outside of the tire. The box,

which contains a reservoir for oil, is formed with its flange in one casting, the outside diameter of the flange being the same as that of the front bind-plate, which is like a large wrought iron washer, and shown detached at fig. 3.

Screw bolts pass through the back flange, spokes, and front bindplate, the nuts turning against the face of which brace all together as one solid nave. There is one of these bolts to each spoke, as shown in figs. 1 and 3.

The spokes throughout are of a parallel thickness, as shown in fig. 2, the edges being slightly rounded off.

I have not entered into the details of the substance of metal and wood, as this must necessarily depend upon the size of the wheel, as well as the work it is required to perform. Having worked many such wheels on my carriages, I can say, from experience, that they are all that can be required in a wheel; they combine permanent strength with comparative lightness, and are by no means expensive in their first cost.

I am, sir, yours, &c.

WALTER HANCOCK.

Stratford, Essex, January, 1834.

P. S.—The Infant has a set of *dished* wheels on this principle, now in good condition, after having performed work which would have worn out two or three sets of wheels of the common construction.

NEW ERA OF STEAM POWER.—Mr. BURDEN is progressing rapidly in the construction of his boat; it will be in operation on or before the first of June, and we have no doubt will realize the most sanguine expectations of the *inventor* —if inventor we dare call him, for, as will be perceived from the annexed communications, there are several who set up a previous claim. But, as a contemporary well observes,— "Other men broke stones before MACADAM, but HE broke them to such effect as to be justly deemed an inventor. Other men, in like manner, may have observed the extreme buoyancy of the barrel before Mr. Burden; but the successful application of these principles we do think should entitle Mr. Burden to the title of inventor."

We have received the following from MR. HARRIS, in reply to ARCHIMEDES, published in our last number.

NORFOLK, Va., April 12, 1834.

SIR,—I have read with no little amusement, in your last number, a communication relative to my Twin Boat, by a writer who signs himself Archimedes. As he manifests a very laudable desire to prevent people from being "imposed upon by plausible appearances," I have been induced to present for his consideration, through the medium of your valuable journal, some few facts and views which I have no doubt will disperse from his mind the mists of error by which he now appears to be so completely and unconsciously enveloped, and enable him hereafter to direct with the confidence of truth the patronage of "persons possessing both the means and disposition" to patronise valuable improvements. As in my letter, published in your last number, I have publicly condemned Mr. Burden's boat, I deem it proper to state here that I did not intend that letter for the public. Had that been my purpose I should have made no particular allusion to Mr. Burden's boat, but should have left the public to make their own comparisons. I would not be understood as condemning that letter on account of such particular allusion, (for the publication of Mr. B.'s invention made it a fair subject of public discussion, however rigid,) but merely as intimating that, having no wish to make strictures publicly on any man's concerns, and especially to commence a discussion, I should have been for that reason unwilling to have singled out Mr. Burden's invention, as if for the purpose, it would seem, of inviting controversy. My agent, to whom, and for whom alone, I intended that letter, not knowing my sentiments on this subject, judged that, as an advertisement of my invention, that letter would serve a good purpose, and on that account, and not with a view to the injury of Mr. Burden, published it, being perfectly justified in the act by the general principle, that whoever voluntarily introduces his opinions, conduct, or concerns, to public notice, renders them ipso facto justly amenable to public discussion, and in that sense public property, respecting which any man possesses the indubitable right of expressing his opinions, temperately, whether adverse or otherwise. As that letter is published, and as the remarks of Archimedes call for a reply, I am now, of course, compelled to sustain, as well as I may, by all fair means, my unfavorable opinions of Mr. Burden's invention, which I shall do, entertaining not the least personal hostility against that gentleman, with whom, in fact, I am unacquainted and whom I never saw. If Mr. Burden's plan of constructing twin boats is superior to any yet discovered, Archimedes may rest assured that a comparison of it with mine will redound to the advantage only of Mr. B.

Archimedes denies to me the merit of invention, because it appears that a Mr. Simon Fairman, in 1817, at Middletown, in Connecticut, made a very "wonderful discovery" of what was, all persons must allow, according to Archimedes' statement, a "wonderful" boat indeed. This boat of Mr. Fairman's, only 35 feet long, was, it appears, sufficiently buoyant to carry men enough to propel it at the rate of *considerably more* than five miles per hour, carrying also the weight of passengers, their baggage, &c.

Now, sir, this boat could not have been "in all respects precisely" like mine, for had it been

constructed on my plan it would not have been sufficiently buoyant to have carried all the weight above mentioned, and have ventured in to the sound, because its length (35 feet) would have of necessity rendered its other dimensions altogether too contracted for that purpose. What is called a six knot sailing breeze would have raised a sea sufficient to have subjected the passengers and workmen to a rather disagreeable and continued cold bath of several inches on deck; and as for cabins, not one fourth of a moderate number of passengers could have stowed themselves in the narrow and shallow holds of so small a twin boat as one built on my plan, only 35 feet long, must of necessity have been. Why, sir, a boy of eight years only could not have sat upright in one of them. But I do not by any means rest on this difference in proportions as a proof that my invention is one sui generis and not identical with Mr. Fairman's boat. That difference, although in itself strong, is comparatively my weakest point, and on that account I present it first. Had I, after splitting, as it were, a single boat apart, left the inner, or, as A. terms them, "approximate"* sides, perpendicular, I should have arrived but half way to the completion of my invention. I found by inclining those sides at a very considerable angle towards each other, either in a right lined or curvilinear angle, that many various and important advantages were thereby attained, without losing the advantages resulting from the longitudinal parallelism of those sides. This inclination destroyed their vertical parallelism to each other, and thereby rendered the boat essentially different in *form* as well as in *properties* from Mr. Fairman's or any other kind of boat.

In my published letter I did not even mention the curvilinear inclination, for wishing to illustrate my plans by figures, I perceived that no figure which I could draw would be likely to convey a correct idea of that peculiar form, but, on the other hand, would rather be apt to create the impression that I had resorted to something like the five mile "swell" of which Archimedes speaks. That my agent might obtain a full and clear understanding of my invention, I went regularly to work and first built on paper a single boat, of such dimensions, be it observed, that she would be rendered by them, *as a single boat*, entirely useless. I then proceeded to divide her, and by the division made the straight inner sides perpendicular. Before altering this perpendicularity, I proved her to be superior to Mr. Burden's boat, on account of the straightness of the inner sides being "a principal point of superiority." In this particular, a *half stage* only to the completion of my invention, it appears that Mr. F. had preceded me, though it would seem in so *inefficient* and *imperfect* a manner as to cause him to condemn it and resort to *curved* inner sides. It appears that he preceded Mr. Burden in building *twin* boats, and therefore, on that ground, (namely, their being twins,) may as well dispute the merit of invention with Mr. B. as with me. These (Mr. F.'s) inner sides, by being ultimately *curved*, exactly resembled Mr. Burden's, but even in their original perpendicularity they were essentially different from my inclined sides, both in form and properties. It will not do for Archimedes, or any one else, to say that Fairman's boat was composed *of timbers and plank*, and therefore not similar to Burden's, which is composed of *staves*. The *materials* have nothing to do with the question, but the *form* only. I may with as much propriety build a commonly modelled boat of tin, and then get out a patent to prevent people from building such modelled boats from wood. If Mr. Burden chooses to build vessels from coopers' ware, and get out a patent for a new application of staves, why, let him do so; but he certainly cannot prevent men from using the common materials of vessels in constructing *long, narrow, shallow*, twin boats, having *curved* inner sides. I claim to have invented the *right lined* and *curvilinear inclined* inner sides as an "important and original improvement"* on the straight parallel inner sides, which latter resemble mine only in their straightness and parallelism to each other.

After having proved in my published letter the superiority of the *perpendicular*, straight, parallel inner sides over Mr. Burden's *curved* inner sides, I then brought forward the inclination, which, I take pleasure in informing Archimedes, is a great *distinctive* and original merit of my invention. If Archimedes desires it, I can send him a copy of my specifications, in which I distinctly state that, "*as an original and important improvement, the horizontally straight perpendicular inner side of each twin can be inclined at any desired angle*;" and then proceed to lay down the various advantages obtained by this inclination, from which he can perceive that I do not consider the straight *perpendicular* sides as any thing very superior, though he can perceive from my published letter, and I now repeat, that I think them far superior to Mr. Burden's curved inner sides. Did I suppose you would allow room enough in this number of your journal for the subsequent matter of this communication and for the advantages, and their reasons, resulting from the *inclined* under sides, I would give them now. However, if A. desires it, he shall have them in a future number.

I would inform Archimedes, as a further distinguishing mark of *originality*, that in proportion as my *crescent-shaped* keels rise from a horizontal line they have a certain *lateral* inclination, such inclination being proportioned to the inclination of the inner sides; by which contrivance no curve is created on, but perfect parallelism of the inner sides is preserved.

* Strictly they are not approximate, for the two sides of either *one* of the twins being nearer to each other than the inner side of one twin is to that of the other, are, of course, what would come under the term "approximate," from the very derivation and meaning of that word. I grant that the reader of A.'s remarks would know by the term "approximate" that he means the inner sides, because he speaks of their peculiar characteristics, straightness and parallelism; still, the term used as A. would is not correct.

* The very words of my specification.

This lateral inclination of the keels, as they rise fore and aft towards each extremity, would cause a person, not critically viewing the matter, to suppose that the space between the twins at the centre would be greater, or wider, than that at either extremity; but an ocular examination of a model, (which my agent will with pleasure exhibit,) need only be made to prove that the parallelism of the inner sides could not otherwise be preserved, and that the space referred to is not wider than that at either extremity. Were the keels horizontal, or level, then not they, but the stem and stern posts only should be laterally inclined. Properly speaking, my boat has no stem and stern posts, for the pieces of timber which in common vessels would form those parts, are in my invention nothing more than a continuation and portions of my *curved* and *laterally* inclined keels. I have now, Mr. Editor, I think, fairly and clearly proved that my invention is a different thing altogether from Mr. Fairman's; and any man who, after reading the foregoing matter, would say that it is not different, and at the same time assert that Mr. Burden's invention is different from Mr. F.'s "swell" boat, would not excite the least surprise in my mind, if he should forthwith seriously set about proving that the moon is made of green cheese. But I have not done with Mr. Fairman's boat: I must sail a few miles further in her, and fully test her qualities.

It plainly appears, from the astounding "swell" mentioned by A., that there must have been some radical malconformation in Mr. F.'s boat not made public, perhaps unknown, by A.; for were it otherwise, Mr. F. never would have applied an obstruction to speed, and a cause of dead or back water, for the purpose of *diminishing* back-water. I say obstruction, for no man will have the hardihood to assert, that two boards set on edge, perpendicularly, in the water, whose ends at each extremity are at equal distances apart, but whose centres are sprung or bent in towards each other, can be moved in the direction of their length with a facility equal to that of the same boards when perfectly parallel from end to end. Yet a man who asserts that the "swell" *increased* the speed of Mr. F.'s boat, makes a much more unreasonable assertion.

Archimedes must not misunderstand me. I do not mean that he asserts what he does not believe, but I mean to say that the increase of speed could not have been the result of this swell, but of some other cause not observed, or not now recollected by Mr. F. Another glaring absurdity is involved in the assertion that Mr. F.'s swell increased the speed of his boat. Any person in the least acquainted with the subject must be aware that, of two boats having equal draft of water, the one which is *wider* will not under the same power move so fast as the other and narrower boat. Now, sir, Mr. F., besides partially choking up the straight passage between his twins, *adds* to their width by applying his swell, and yet, through his friend A., tells us that in consequence thereof his boat moved faster!! I do not call in question Mr. Fairman's veracity, or impute to him a designed omission of any particular necessary to be known in arriving at a correct understanding of his invention; but I must be allowed to suggest, whether he has, after the lapse of seventeen years, called to mind *all* the particulars of an experiment, which, it appears, after all, resulted in proving his invention to be useless. His friend A. evidently believes, and endeavors to prove, that it was a failure, for he says it was "previously like" mine, (but "I wish to inform him that he is completely mistaken, and he could not be more so;") and the whole drift and scope of his argument goes to prove (in *his* estimation) that my invention will not succeed.

If he thinks it is so manifest a failure, I think he pays, by arguing on it, no great compliment to the northern capitalists, a body of men of whose intelligence and general information I have always entertained so high an estimate as to suppose that no addition could be made to their ideas by the slight amount of argument which A. has deemed sufficient to expose the futility of my plans.

Some of the *facts* stated (no doubt sincerely) by Archimedes, are in direct opposition to previous and subsequent experience: the cause of back-water, the result of the "swell," and the comparative resistance experienced by the inner and exterior curves, being instances.

If *all* the particulars of Mr. Fairman's experiment have been recollected and told us, and if there has been no mistake, then, sir, I stand prepared to prove, that a hollow tin cylinder, perfectly open at both ends, will move on end horizontally through the water with more difficulty than a common tin tunnel in the same position, whose mouth or larger orifice shall be the forward end, and in diameter equal to that of the cylinder.

The fact is, that enough, fully enough, has been stated by Archimedes, to prove that Mr. Fairman's useless invention was nothing more than a division into two parts of a single boat of the usual model and proportions. Archimedes does not tell us how fast Mr. F.'s boat moved before the application of the wonderful swell, although he says the average gain resulting from the swell was *five* miles per hour; but, allowing, for arguments sake, that this swell was no obstruction, still no man in his senses can believe that the gain was ten per cent. on the original speed. Allow this gain, however, and by calculation we find her *improved* speed was just 55 miles per hour!! As a low rate of increase produces such astounding results, we will endeavor to get this famous boat out of difficulty by supposing the gain to have been equal to the incredible quantity of 50 per cent. and we then find that her ultimate speed must have been 15 miles per hour!

This will never do: we will therefore make one more effort to bring her within reasonable bounds as to actual speed, by going *out* of all reasonable bounds in assigning her increase of speed, from the application of this unmanageable swell, to have been 100! per cent.; yet, allowing the increase to have been this, I may

safely say, physically impossible quantity, and we then find that Mr. F.'s boat moved at the rate of 10 miles per hour, a velocity equal, if not superior, to the rates of any steamboat of that day, and which should therefore have been immediately instrumental in covering our waters with Fairman's *swell* boats, worked by men or horses. What the Connecticut people could have been about, when they permitted such an invention to slip through their fingers and be carried to Demerara, I cannot conceive, for it certainly must have been amongst Connecticut vessels a *swell* dandy of the first order. At all events, Archimedes, who alludes to my prudence respecting my heirs, must allow that Mr. F. did not manifest the usual prudence of the sharp-witted New-Englanders, when he sold so *valuable* a boat for the pittance $300, and took no further steps for the benefit therefrom of himself and heirs. Archimedes has put his friend between the horns of a most provoking dilemma. Should he state the gain resulting from the "swell" to have been within any reasonable bounds, say 5 to 10 per cent., he virtually asserts that the improved speed of the boat was 55 to 105 miles per hour!! If, while advancing through the air at such a rate, he should be able to catch his breath and tell us that this astonishing speed is imaginary, and the result only of stubborn, unbending arithmetic, and that the actual velocity of the boat was only 8 or 10 miles per hour, he thereby makes the incredible statement, that this magic swell conferred a gain of 100 to 166 per cent.!! Why, sir, had I been the proprietor of that "wonderful" boat, I should have gone on *swelling* her at so swelling a rate, that in my exultation, not recollecting the well known catastrophe of the frog *aping* the ox, I should have probably paid so little attention to her powers of endurance as to have absolutely caused her explosion into thin air. With respect to the back-water mentioned by A., I will inform him that it could not by any means have been created by the straight *unobstructing* sides. Does not A. know that back-water is caused by *obstructions?* If he needs explanation, I beg to refer him to "Observations on the Prevailing Currents of the Ocean," as published in your last number, and he will there find the subject handled in a masterly manner, and I trust to his satisfaction. The hollow in the water which he alludes to, with the evident intent that the reader should consider it as a result of the straight sides, was caused by the action of the wheel, and was by no means an evidence of back-water. He ought to know that all paddle wheels, revolving in the water, create waves, and of necessity hollows, and that hollows resulting from such a cause are no evidence of back-water. He, or rather Mr. F., saw the hollow; and A., without further ceremony, assumes it to have been back-water.

I have now done, Mr. Editor, with Fairman's famous swell boat, unless, indeed, some one of the water gods should buoy her up to the surface, and by putting her in my way render it necessary for me to run her down again.

I have, sir, more than once in my life, had occasion to observe how very easily a false issue can be made up on any subject, and the weaker side of an argument be thereby made to appear the strongest. This remark is called forth by the "best way to decide the point" of strength between Mr. B.'s and my inventions, as suggested by Archimedes. I will grant, to his utmost desire, that arches are stronger than angles, and that a barrel will resist external pressure longer, and of a greater amount, than a box would, made of the same kind and quantity of materials. Granting all this, I still assert, with perfect confidence of its truth, that my twin boat, (that is, the *whole* fabric,) can be constructed vastly stronger than Mr. Burden's, and would in consequence be enabled to endure firmly and uninjured the severity of a gale at sea, which would be sufficient to rend Mr. B.'s twins asunder, and scatter them and their superincumbent cabins and fixtures on the surface of the waters. I said a false issue can be easily made up, not meaning that Archimedes would designedly do so. He, I have no doubt, is fully persuaded in his own mind, that the barrel and box test decides the question, and is not aware that when he proposed that test he was making up a false issue. The question is not whether *one* barrel thrown into the water is enabled by its circular or arch-like form to endure greater pressure therefrom than *one* box, but whether two barrels can by any possibility be *connected* externally in a manner better to resist the violent tendency of the waves to separate them than two boxes: said boxes, please to observe, having the advantage of stout internal frames, *upon* which the exterior planks are secured, and the connecting pieces or timbers of which boxes are not secured upon those planks, but inserted through them into the boxes, and forming part and parcel of those frames. Were my twins formed merely of the exterior planking, having no keels and timbers, or internal frames, I would by no means assert that *one* of them would be in itself stronger than one of Mr. Burden's, and better able to resist the compressive power of water. But whoever heard of any the least detriment happening to vessels as now usually constructed with keels, and timbers, from compression of the water. Why, sir, this unalterable property of water is a source of safety to vessels properly put together, for were it suddenly to be annihilated, and its other properties still exist, every *freighted* ship on the ocean would be so much ruptured by the expansive weight of her cargo as to soon go to the bottom. Whether *one* of Mr. Burden's twins is or is not able to resist the compressive power of water better than one of mine is a question in which no one can take any interest, until the heretofore immutable laws of nature become so altered that the power in question shall be able to crush together the two sides of vessels as now usually built. When that period arrives I think it will be time to discuss the question, and I am strongly of opinion, that I should find ample ground upon which to uphold the keel and timbers, (that is,

the *back-bone* and *ribs,*) the knees, braces, and planks, against mere planks alone, whether those solitary planks are put together arch-like or otherwise.

If Mr. Burden pierces his twins, (thereby, observe, injuring the arch principle of his invention,) and introduces therein frames similar in any respect to keels and timbers, or to any thing else, into which he would secure his connecting timbers, he does just what I do, and therefore cannot connect his twins by that means stronger together than I do mine. But, as I am informed, and agreeable to the published description of his boat, he does not introduce frame work within his twins for the purpose of securing them together, and therefore must connect them by external fastenings, that is, fastenings secured to the *exterior* of the twins. When practical, scientific ship-builders pronounce such a mode of fastening twins together to be superior to mine, I shall then begin to think I am in error, but the opinion of Archimedes is not a lever of sufficient power to disturb my confidence on that point in the least.

Before I let the barrel of Archimedes off, I feel bound to give it a few more buffets, which its arch-like structure may perhaps enable it to withstand.

Arches, we all know, when sustaining a very severe pressure, especially if it comes against them with a *sudden* and forcible momentum, are intended to receive that pressure *spread equally* over all parts, or else it might, by being concentrated at one or two points, be sufficient to break an arch which it could not even shake were it to bear equally on all points. Recollecting this, we will take Mr. Burden's and my inventions to sea, in a heavy gale, and in endeavoring to escape its fury we both unconsciously steer towards a hard sand bank, upon the ridge of which our boats strike for some time before we can force them over. The sides of this ridge being known to be quite shelving and steep, we thereby ascertain that at every blow or descent in the trough of the sea, a surface of twelve square feet only of the bottoms of our boats is brought in contact with it. Now, sir, here is violent and sudden pressure concentrated to a point with a vengeance, and I think, if you were on board my boat, that you would congratulate yourself that you had gotten a firm stout frame and planking outside of that between yourself and the ridge, instead of the bare staves of Mr. Burden's boat. I doubt not that you could tell without hesitation which boat would be soonest broken through. "So much" for the comparative strength of the two inventions. Archimedes asserts, that by making the inner sides straight I only remove the angle of resistance to the exterior side. I beg you to observe, that he here calls the curve of the inner sides, that is, the "swell," an angle of *resistance,* and yet, by applying this resistance, Mr. F. *increased* the speed of his boat!

I agree with A. that I remove an angle of resistance; but is he not aware that I diminish the *degree* of resistance by that removal? The last paragraph but one before the postscript of my published letter I should think ought to have suggested to him the reason why I diminish the resistance. His not perceiving it satisfies me, that, like his great namesake, he knows better how to set about *destroying* vessels than how they act upon, or are effected by, the water.

But to the point: we will suppose that the water impinges upon the two bows of a vessel sailing at a certain known rate, with a constant force of 1000 lbs., which force, setting aside the inertia resulting from the gravity of the vessel, is the only opposition to her keeping pace with the wind.

Of course, two such vessels, not at all connected, would be impinged upon, sailing at the same rate, with a total force of 2000 lbs. Connect those vessels, so as with them to form a common twin boat, and then, sir, although the two exterior bows would be resisted only by the original force of 1000 lbs. the two inner ones would immediately experience a *greater* opposition, which would be in proportion to the proximity of those inner bows to each other, as well as proportionate to other particulars, such as moving power, angle of the bows, &c. Why? Because the exterior bows could, as when the boats were unconnected, easily dissipate and disperse the impinging water in the shape of a swell, or wave, that would be *left behind* rolling along on either side; but the two inner bows would, as to this dispersion, act in opposition, and would thereby immediately accumulate a head of water, which they would have to *force* along *before* them constantly, and make it keep pace with them at any rate of speed, because more water would make its entrance in any one moment of time between those inner bows than could in the same space of time pass out from between them at the point where they converge towards each other. It must be admitted, of course, that, as connected twins, these two vessels would experience more opposition to their motion than 2000 lbs., the amount experienced when single. By removing the inner bows, or angles, and placing them wholly on the outside, I should have to work against the original amount of resistance 2000 lbs. only.

Mr. Burden's inner as well as exterior bows, or angles of resistance, are so very acute, as to the careless spectator thereof might appear too trifling to create much opposition; but, let that spectator reflect on the degree of opposition which must inevitably result from the motion of a volume of water 21 or 22 feet wide, with a velocity of 12 or 15 miles per hour, through a passage not over 150 feet long, and whose width decreases gradually to its outlet, until it is there only 16 feet.

If dead water, as sailors term it, or back-water, according to Archimedes, would not be created thereby, both at the head and stern, I must confess that I am at sea on this matter without rudder or compass. That a twin boat built on my plan would be superior to one on Mr. Burden's, in point of draft, was, I think, clearly proved in my first letter, and therefore

needs no further argument. Archimedes does not deny it. After having read the foregoing matter, Archimedes must in candor allow—

1st, That I am the inventor of the boat described as mine;

2d, That it is different from Mr. Frirman's;

3d, That it is superior to Mr. Burden's, in the matter of its parts being strongly connected together;

4th, That it has less draft than his; and

5th, That the straight passage in the centre of Mr. Fairman's boat, as *originally* planned, or of mine according to its *unchanged* plan, *is* an advantage over Mr. Burden's boat.

That this communication will operate "for A.'s future benefit, and the benefit of others," is my sincere wish and its object.

Before concluding, I deem it necessary to state, that my letter, as published in the Evening Star, from which I suppose you copied it, was printed very imperfectly; several omissions of single words, and, in one instance, of a *whole line*, having been made, by which the true meaning in some parts is almost wholly obscured. When I learned that it was to be republished by you, I forthwith sent on directions for it to be corrected, but they arrived too late. I am, sir, very respectfully, your obedient servant, CHARLES HARRIS.

Harris' Steamboat. By A KNICKERBOCKER. To the Editor of the Mechanics' Magazine, and Register of Inventions and Improvements.

Sir,—In your last number I saw a description of a twin-boat patented by Mr. Charles Harris, which he appears to value very highly, and thinks that his boat will supersede that of Mr. Burden.

There were also some remarks from "Archimedes," respecting the above invention, and stating that a Mr. Fairman, of Middletown, Ct., had constructed a similar boat in 1817.

I wish to inform Mr. Harris, (as it may probably save him or his friends considerable expense,)—also Archimedes,—that during the late war, Robert Fulton built for the United States' Government the steam-frigate "Fulton the First," and that she was "split into equal parts longitudinally, from stem to stern, down through the keel, and the two halves placed a distance from each other in parallel lines, and joined above water by timbers and decks in the most substantial manner." Previous to or about the same time, I saw a boat built on a similar plan, called the "Happy Couple." Not answering the expectations of the projector, the Couple were cut asunder, the beams shortened, and the two halves fastened together by the keels, stems, &c., and thus made a single boat. She was then used as a sail-boat. I have sailed in her often. Her projector, Mr. I. J., now resides in this city. A KNICKERBOCKER.

New-York, April 7, 1834.

The following communication, disputing the claim of Mr. Burden to be considered as an inventor, appeared in the Quebec Gazette of 2d April, 1834.

To the Editor: Sir,—It is generally the case that those who bring into practical operation any invention in the arts,—if that operation be attended with great public advantages,—the enterprising individual who has been the means of securing them receives the merit of the invention.

The steamboat first practically introduced on the Hudson, by Fulton, had many years before been put in operation near Glasgow, and then Fulton, a native mechanic, assisted the real inventor, and brought with him to America the labor, genius, and experience of his master.

What is now called *Burden's boat* is not new. A boat exactly of a similar construction as to form, and differing in no wise except in the hull, which in the latter is on the principle of a common barrel; has been publicly moving across the Frith of Tay, at Dundee, in Scotland. A simple description given in the London Penny Magazine, for July last, will convince every one that Mr. Burden's invention is, so far as we know, limited to a mere barrel build, (and even this may not be his own, as Annesley's ships, built in Quebec, were at least nearly similar,) which affords lightness and buoyancy, but which is attended with great danger on the boat's striking.

"The common road from Edinburgh to Dundee runs in nearly a straight line from Pettycur through the county of Fife, and across the Frith of Tay, which at Dundee is about two miles in breadth. There is, on this passage, an excellent steamboat of a peculiar construction, the paddles being placed in the middle, as if there were two boats joined, and the form being such that it moves equally well with either end foremost."—[From the Penny Magazine, Monthly Supplement for July, 1833, page 293.]

O. Q.

Experiments made on the Forth and Clyde Canal, to ascertain the best form of Canal Boats. By J. ROBINSON, Esq., Secretary of the Royal Society of Edinburgh. [From the Transactions of the Society of Arts, Second Part for 1833.*]

In the way in which experiments to ascertain the forms of least resistance of floating bodies have generally been made, so costly an apparatus, and so much precision and skill in observation, have been required in order to give any value to the results, that comparatively few persons have been enabled to undertake such investigations, notwithstanding the obvious advantage to be derived by those interested in canal navigation, from an accurate knowledge of the forms most suitable for vessels, according to the circumstances under which they are to be employed.

The great increase of speed which has lately been effected in railway carriage having made

* Mr. Robinson was presented by the Society with their large silver medal for this very valuable communication.

it expedient that corresponding improvements should be introduced into the transport of goods on canals, it became the interest of canal proprietors to use active endeavors for this purpose. The directors of the Forth and Clyde canal have shown themselves particularly well disposed to encourage such investigations, and have applied a considerable portion of their revenue to the construction of experimental steam-vessels, and to the improvement of the facings of the canal, so as to admit of the transit of large vessels at rates of speed which, until lately, have been supposed impracticable in confined water.

In order to obtain a maximum of effect from the power employed in such steam-vessels, it was necessary to ascertain as nearly as possible the form which should be given to their bodies: and as much diversity of opinion existed on this point, I ventured to suggest to the directors that experiments should be made on the canal with models of a sufficient size to admit of safe conclusions being drawn from the results of the trials.

In consequence of this suggestion, four models were prepared, of the following dimensions:

No. 1 was 8 feet 3 inches long, 2 feet wide, and 1 foot deep;
No. 2 was 8 feet 3 inches long, 2 feet wide, and 1 foot 6 inches deep;
No. 3 was 8 feet 3 inches long, 2 feet wide, and 1 foot 6 inches deep;
No. 4 was 9 feet 1 inch each part, 1 foot wide, and 1 foot deep;
And the weight of each 187½ lbs.

No. 1 was quite flat on the floor, rounded at the bilges, and perpendicular in the sides at the midship section, but with a fine entrance and run.

No. 2 was made in the proportions of an ordinary coasting trader.

No. 3 in the proportions of a sharp-built schooner.

No. 4 was a twin boat, similar in its sections to No. 1, only that the breadth of each portion was half of the other breadth, while the depth was the same.

The weight of all the models being alike, their displacement of water was equal, although their draft, or depth of immersion, was necessarily different.

The usual way of trying the resistance of floating bodies is by drawing them across a dock or basin, by a cord running over delicately hung pulleys on a high mast, and with certain weights attached: the time is accurately noted which each form requires to move through a certain space, and the comparative resistances are calculated from these elements. This method presents many difficulties and disadvantages; and I therefore resolved on adopting a different one, which should admit of each experiment being carried on through a much greater space than can be accomplished by means of cords and pulleys. My first intention was to tow each model by a long slender line from the after part of a light steamboat, which was capable of running about seven miles per hour in the canal. This line was to have been attached to an hydrostatic dynamometer, and by this means the strain exerted on the towing line at every different rate of speed by each of the models *in succession* might have been approximated. I was enabled, however, by a suggestion from an ingenious friend (Mr. Oldham, of the Bank of Ireland), to adopt a much more summary and satisfactory way of determining the comparative resistance of the different models; and as it was the *comparative* resistance alone which required investigation, there could be no inducement to go through the more tedious process of trying the resistances separately, and of incurring the risk of error from mistakes in reading off the indications of the dynamometer.

I prepared accordingly a spar or yoke, of 16 feet 8 inches long, which was divided into 100 parts of 2 inches each; a small eye-bolt was fixed at each extremity, and a shifting hasp fitted to the middle part. With this yoke all the experiments were made by the two following processes. 1st, a model was attached by a slender towing-line to each eye-bolt, and the hasp was fixed exactly in the middle of the yoke, and linked to an outrigger on the steam-vessel, which was then set in motion at the required speed. If it was found that one of the models preceded the other, in consequence of its offering less resistance, the hasp was shifted along the spar towards the sluggish one, until the resistances were balanced, and the two models ran abreast of one another. The relative lengths of the arms of the yoke then gave an inverse measure of the comparative resistances of the models, *at that* rate of speed; this being noted down, the hasp was brought again to the middle of the yoke, and the model which showed least resistance was by degrees loaded with weights until it again exactly balanced the other, and swam abreast of it; the amount of the added weights being likewise noted, afforded a second measure of the difference of the resistance of the two models.

Each of these forms of the experiment was gone through with different pairs of the models, and was frequently repeated through long spaces of the canal, as it was found that various circumstances interfered to render the resistances inconstant, such as approaching nearer to the one or the other side of the canal, passing a loaded vessel, or making a turn round a projecting part of the bank.

It was at first attempted to conduct the experiments by towing the models astern; but it was immediately found that the ripple of the wake of the steamer disturbed the uniformity of the resistance of the models. Various modifications were then tried with more satisfactory results, and finally the arrangement was made as follows: A spar, like a bolt-sprit, of about twenty feet in length, was run out a little above the level of the water from the bow of the steamer, the hasp of the yoke being attached by a link to the point of this spar, the models were in this way kept ahead of the steamer in smooth water, and were altogether undisturbed by any ripple or wave.

Table A.—Experiments with equal Loads.

Models tried.	*United Weights of Vessel and Load.*	*Divisions in the Arms of Yoke when at 3 miles per hour.*	*Difference.*	*Divisions in the Arms of Yoke when at 6 miles per hour.*	*Difference.*
No. 1. Flat Vessel No. 2. Coaster....	192 each	48 52	4 div. or 1-12	50 50	None.
No. 1. Flat Vessel No. 2. Coaster....	256 "	46 54	8 div. or 1-6	50 50	do.
No. 1. Flat Vessel No. 2. Coaster....	320 "	47 53	6 div. or 1-8	49½ 50½	2-100 parts
No. 1. Flat Vessel No. 2. Coaster....	392 "	45 55	10 div. or* 1-5	49 51	2 div. or 1-24.
No. 1. Flat Vessel No. 3. Schooner..	192 "	45 55	10 div. or* 1-5	50 50	....
No. 1. Flat Vessel No. 3. Schooner..	256 "	43 57	14 div. or 1-3	50 50	....
No. 1. Flat Vessel No. 3. Schooner..	320 "	44 56	12 div. or 1-4	uncer- tain	
No. 1. Flat Vessel No. 3. Schooner..	392 "	45 55	10 div. or* 1-5	49 51	2 div. or 1-24.
No. 1. Flat Vessel No. 4. Twin do..	256 "	50 50	0 0	uncer- tain	.... in favor of No. 1.
No. 1. Flat Vessel No. 4. Twin do..	320 "	53 47	6 div. or 1-8	uncer- tain	.... in favor of No. 1.
No. 1. Flat Vessel No. 4. Twin do..	392 "	52 48	4 div. or 1-12	uncer- tain	.... in favor of No. 1.

Table B.—Experiments with equal Arms of the Yoke at 3 miles per hour.

Models compared.		*Depth of Immersion in inches.*	*Weight of Vessels with their Loads.*	*Difference.*	
No. 1 No. 2	Flat Vessel.. Coaster.....	4·91 8·5	256 lbs. 288 "	32	No. 2 carries 1-8 more than No. 1.
No. 1 No. 2	Flat Vessel.. Coaster.....	6·083 10·083	320 " 392 "	72	No. 2 carries 2-9 more than No. 1.
No. 1 No. 3	Flat Vessel.. Schooner ...	4·17 8·41	192 " 234 "	42	No. 3 carries 2-9 more than No. 1.
No. 1 No. 3	Flat Vessel.. Schooner....	5·75 10·25	320 " 362 "	42	No. 3 carries 2-15 more than No. 1.
No 1 No. 4	Flat Vessel.. Twin Vessel.	4·17 4	256 " 256 "	00	No difference at this rate of speed.

N. B.—The depth of immersion entered above is that observed when the vessels were at rest, and which did not appear to alter when in motion.

Table C.—Experiments with equal Arms of the Yoke at 6 miles per hour.

Models Compared.		*Immersion in inches.*	*Weight of Models when loaded.*	*Difference.*
No. 1. No. 2.	Flat Vessel.... Coaster.......	4 2-12 6 4-12	192 lbs. 192 "	—
No. 1. No. 2.	Flat Vessel.... Coaster.......	4 11-12 8 1-12	256 " 256 "	—
No. 1. No. 3.	Flat Vessel.... Schooner shape	4 7-12 7 9-12	192 " 192 "	—
No. 1. No. 3.	Flat Vessel.... Schooner shape	4 11-12 9 2-12	256 " 256 "	—
No. 1. No. 4.	Flat Vessel.... Twin Boat....	5 9-12 5 7-12	320 " 320 "	—

The draught of water noted in the column of immersions was that observed when the models were at rest previous to the commencement of each experiment; the actual immersion during the experiment was considerably less, especially in the flatter vessels; but there were no means of ascertaining it precisely.

The accompanying tables contain the results of these trials, from which the important inference may be drawn, that there is no form which will present a minimum resistance in all circumstances; and that the form which is easiest drawn through a canal at a low velocity does not possess the same advantages at a higher rate of speed.

By looking into the table A, experiment 1st, we see that, although the resistance of No. 1 be to that of No. 2 as 13 to 12, when the velocity is 3 miles per hour, yet when the speed is increased to 6 miles, the advantage which No. 2 had over the flatter vessel entirely disappears.

Again, in table B, we see that in one experiment No. 2 carries two-ninths more weight than No. 1, with equal resistance, when the velocity is 3 miles per hour; but that when the rate is raised to 6 miles, the loads require to be made the same in both, in order to equalise the resistance.

It appears, from numerous experiments made at intermediate speeds, that this change in the relative resistance is progressive; there is reason, therefore, to conclude, that if circumstances had admitted of carrying on the experiments at a higher velocity than 6 miles per hour, the flatter formed vessel would have attained a superiority over the sharper ones: this conclusion is corroborated by the fact, that the swiftest going steam-vessels which have been built in this country are those which are nearly quite flat in the floor for a great proportion of their whole length.

The first practical inference which may be drawn from these experiments is, that all vessels which are intended to be tracked, or impelled by machinery, through canals at low velocities, should be built as sharp in their bottoms as circumstances will admit of, although this must necessarily increase their draught of water; the second inference is, that whenever vessels are intended to move in canals with a higher rate of speed than 6 miles per hour, the general form of the bottom should be nearly quite flat.

Important Discovery.—We learn that Mr. George B. Moores, of this village, has invented a process for the application of steam power, so that boats, carriages, &c. may be propelled with the same velocity they now are, with one-fifth of the fuel which is now used for that purpose. From the representations of several scientific gentlemen who have investigated the subject, we feel warranted in predicting that Mr. Moore's discovery will prove as beneficial to the world as was the original invention of steam-engines.—[Union Village Banner.]

Specification of a Patent for Furnaces for Generating Heat by Friction, and applying the same to economical purposes. Granted to John W. Cochran, *Lowell, Middlesex county, Massachusetts, November* 19, 1834.

To all whom it may concern, be it known, that I, John W. Cochran, of Lowell, in the county of Middlesex, and state of Massachusetts, have invented a *Friction Furnace* for generating heat without the consumption of fuel, and applying the same to economical purposes; and I do hereby declare that the following is a full and exact description of my said invention.

Although the fact that heat may be generated by friction is one of universal notoriety, it does not appear that the idea of applying this heat to economical purposes has ever been practically acted upon; I, however, have ascertained by satisfactory experiments that it may be done to great advantage. The most convenient way of effecting the object is to prepare two metallic disks, or cylinders, say of cast iron, in the form of common mill stones, and to cause one of them to revolve against the other, under considerable pressure, which pressure may be given by the weight of one of the disks, or by that of a vessel containing water, or other fluid, to be heated, the bottom of which may take the place of one of the disks; or by weighted levers, or in any other way of producing pressure which may be preferred. When I make two disks of this description to rub against each other, I form one or both of them somewhat hollow towards the centre, on the touching sides, as a bearing on that part would tend to diminish the friction towards the periphery, where the motion is the most rapid.

There are many ways in which I contemplate the application of this principle, as, for example, I intend sometimes to cause two disks, such as I have described, to revolve one against the other, by power derived from a water wheel, or from any other convenient source, and to enclose them within a drum, or chamber, into which a current of cold air shall be admitted, and whence it shall be conducted by suitable tubes, after it has been heated by being brought in contact with the disks; thus using it to warm the apartments of any building, or for other purposes. Where steam is preferred, I intend sometimes to allow water to fall in a small stream upon the heated disks, and to conduct it thence through tubes to wherever it may be required. Where steam is to be generated to drive machinery, the bottom of the boiler may be made of suitable form, and to bear upon a disk revolving below it; or the bottom may be perforated, to allow the shaft of a disk revolving in the inside thereof to pass through, and to be turned by any suitable apparatus, by power derived from the steam generated by the heat from the friction, or from any other source.

These various modes will sufficiently illustrate the principle upon which I depend for rendering the heat which was latent, sensible, and active; but I do not intend by this enunciation to restrict or confine myself to the form of apparatus herein described, or to the objects to which it may be applied, but to vary the same in any manner which I may find most convenient and efficient.

It may at first appear that the powerful friction necessary to engender sufficient heat to be usefully employed as a substitute for that extri-

cated in the combustion of fuel, will produce a rapid wearing out and destruction of the rubbing apparatus; I, however, have ascertained, satisfactorily, that when the metals become heated, there is a degree of repulsion produced between them which admits of but little abrasion of their substance.

What I claim as my invention, and for which I ask a patent, is the application of the heat generated by the friction of pieces of metal against each other, to the purpose of heating air, generating steam, and, in fine, to all the economical purposes to which such heat is applicable, proceeding, in its production, upon the principles herein before set forth. JOHN W. COCHRAN.

Observations on Flame—Mr. Rutter's Late Discovery. [From the London Mechanics' Magazine.]

SIR,—There is something very pleasing in applying chemical knowledge to the explanation of the various phenomena that are daily before our eyes. I now propose, with your permission, to make a few observations on the flame of a candle that is now burning on my table. I shall observe, at first, that the heat of the flame melts the tallow, which then ascends the wick by capillary attraction, and is in consequence subjected to intense heat; the tallow is next decomposed, and the principal part of the resulting gas is carburetted hydrogen, which is again decomposed in the following manner: When this gas is first formed, it expands in every direction, and thus getting into the hottest part of the flame, its carbon is deposited in an abundance of fine particles; the hydrogen now increases in volume three and a half times the bulk it possessed when in perfect chemical union with the carbon. This expansion, which is probably again more than doubled by the intense heat of the flame, causes the hydrogen to appear at the outer surface of the flame, where it unites with the oxygen of the atmosphere, and envelopes the white and luminous flame, or that part containing the particles of carbon, with a thin sheet of blue flame.

I now come to a very difficult part of this subject, which, I think, will, when satisfactorily explained, have a great tendency to illustrate Mr. Rutter's discovery of the advantage of burning water with coal-tar, which is by far the greater part carbon; *the difficulty is, to account for the appearance of oxygen in the interior of the flame.* Lord Bacon proved that flame would burn within the interior of flame; and Dr. Ure, in his *Dictionary of Chemistry*, relates a similar experiment, and gives the following definition of flame, founded on the researches of Sir H. Davy: "The flame of combustible bodies may, in all cases, be considered as the combustion of an *explosive mixture* of inflammable gas, or vapor, with air." It may seem very presumptuous in me to differ with such authorities as Davy and Ure, but my defence is, that I regard truth more than all the authorities in the world. I question the truth of the above definition of flame on this ground, that the flames of "*explosive mixtures*" give no light, but afford merely a feeble blue flame. This is the case with explosive mixtures of coal-gas, oil-gas, and indeed all gases containing carburetted hydrogen or olefiant gas; surely, then, the flame of a candle, or of olefiant gas from a small aperture, exhibits phenomena very different from the combustion of an explosive mixture. After giving the aforementioned definition, Dr. Ure says, alluding to flame: "It cannot be regarded as mere combustion at the surface of contact of the inflammable matter. This fact is proved by holding a taper or a piece of burning phosphorus within a large flame made by the combustion of alcohol. The flame of the taper or phosphorus will appear in the centre of the other flame, proving that there is oxygen even in its interior part." This is, in my opinion, no proof whatever of oxygen being in the interior part. There may be carbonic acid, or there may be vapor of water, &c.; and what confirms this conjecture, is the well known fact that carbon can decompose carbonic acid, or at least unite with one atom of its oxygen, thus forming carbonic oxide; for carbonic acid is composed of one atom of carbon and two atoms of oxygen. Carbonic oxide may therefore decompose the vapor of water formed by the union of the hydrogen with the oxygen of the atmosphere, or carbon itself may decompose the vapor of water; this latter is my opinion. But, it may be asked, how does the vapor of water find its way into the interior of flame? In the case of the candle-flame, I apprehend, it is by the union of the hydrogen with the oxygen of the atmosphere at the surface of the flame; and I have before explained that the expansion of the hydrogen, when the carbon is deposited, is the cause of its being projected with considerable velocity to the outer surface of the flame. When the hydrogen thus unites with the oxygen, water is formed, which being immediately subjected to extreme heat, expands with great velocity into vapor, which is projected, not only into the interior of the flame, but from the sides where it is formed. The carbon decomposes this vapor, and, by uniting with its oxygen, hydrogen is again formed, which may be repelled by the sudden expansion which it must have when the carbon seizes the oxygen, to the exterior of the flame, where, uniting with oxygen, it may again return to the interior—and thus play backward and forward many hundred times in a second. This play of affinities would, however, soon cease, were not the supply of hydrogen kept up by the continual and *first* decomposition of the carburetted hydrogen. That vapor is projected from flame is proved when I hold the point of a pair of *cold* steel snuffers within, say three-eighths of an inch of the flame, by moisture being deposited; but the particles are so fine, and in so small quantity, that a dull appearance only of the steel results, which quickly vanishes on their removal. Should the snuffers be held very near the flame,

small drops of water will appear on their removal. As this deposition of moisture takes place when the snuffers are held under the flame, and at a distance of perhaps one-fourth of an inch, I conclude it to be projected with considerable velocity, in the manner before pointed out, from every part of the flame; and I further consider that this atmosphere of vapor may, in some measure, account for the luminous halo which appears to surround the flame of a candle.

There are many other considerations which induce me to believe the above conjectures to be nearly right. One is, that if carburetted hydrogen be mixed with a very small portion of common air, its power of giving light is impaired, for part of the carbon is then burnt in its gaseous combination. Another circumstance that induces me to question the presence of oxygen in the interior of the flame of carburetted hydrogen, is the fact, that a small portion of carbon, when deposited on a small fibre of the wick of a candle, will remain in the white part of the flame without undergoing decomposition. Now, if oxygen were present in an uncombined state, and at such an elevated temperature, who can doubt that an immediate decomposition of the carbon would take place? But, it may be asked, why does not this portion of carbon decompose the vapor of water which you consider to be present in all flames containing hydrogen? One cause may be that the particles of which it is composed attract each other with part of their force, and cannot therefore exert their full force to decompose the vapor. That coal-tar cannot be burned like oil is because it is nearly all carbon, and has not sufficient hydrogen to form the requisite quantity of vapor—what it does possess being only sufficient to supply part of its carbon with oxygen; the other part of the carbon deposited rises from the flame in dense black smoke. It may be further inquired, why does not the black smoke, or the carbonaceous particles arising from a hot flame, unite with the oxygen of the atmosphere, and so form carbonic acid, which is invisible? I apprehend it is because of their low capacity for heat, and the instantaneous radiation of heat from their surfaces; the particles being thus deprived of their heat cannot unite with oxygen, which is also cold—for the union of carbon with oxygen will not take place under a dull red heat. Is it possible, then, to burn coal-tar without producing smoke? Nothing is more easy to a person possessing a slight knowledge of chemistry: let a long tunnel of fire-brick be constructed, leading to a chimney, and let a coal fire be lighted till the sides of this tunnel become of a white heat; if a small stream of coal-tar be now introduced, it will inflame, and as the particles of carbon deposited cannot lose their heat, and will be floating in a strata of air heated to redness, their union with oxygen must take place, provided sufficient air be admitted with the stream of coal-tar.

I shall now conclude with a few words on Mr. Rutter's project of introducing a small quantity of water with the tar. The water will first be formed into vapor, which will require some portion of heat; now this vapor may be decomposed by the carbon, when the hydrogen will again unite with the oxygen of the atmosphere, and vapor will again be formed, till the decomposition of all the carbon is complete. Perhaps two gallons of water is more than one gallon of coal-tar could be made to decompose, and it would be very gratifying to me to see the actual fact proved by experiments so conclusive as to satisfy the doubts of the most sceptical. Your Salisbury correspondent states, that "15 lbs. of coal-tar," which I suppose is about equal to an imperial gallon, "and an equal bulk of water," say 10 lbs, "and 25 lbs. of Newcastle coke, will be found equal to 120 lbs. of Newcastle coal." But this is on the supposition that the whole of the water will be decomposed, which I consider a practical impossibility, for a large portion of the carbon must unite with the oxygen admitted to inflame the hydrogen.

Should Mr. Rutter, however, have formed too high an estimate of the heat gained by his process, there are other advantages attending it which must not be overlooked; for two intense chemical actions are supported with the same volume of air that either of them would require separately, which is of great importance in its application to steam boilers. Your Salisbury correspondent has certainly blundered in endeavoring to explain this. (See his paragraph, page 452, beginning with "Another condition," and ending with "gases.") He is also wrong in saying, (page 453,) "The sides of the furnace in that vessel formed a part of the boiler, consequently their temperature never exceeds that of the contained water." How then is the heat communicated, if both sides are of the same temperature? According to my experience, the sides of boilers are often many hundred degrees hotter than the contained water, and sometimes red hot just at the outer surface.

I have no other object in making these remarks than to elicit truth, and prevent scientific men from trusting too much to "hope's delusive mine." I remain, sir, your obedient servant, WILLIAM WITTY, Jun.

NEITHER LIGHTING NOR HEATING BY GAS OF MODERN ORIGIN.*—In several situations removed from any volcanic action, so far as is visible on the surface, natural jets of inflammable gases are seen to issue, affording decisive evidence of chemical changes that are taking place at various depths beneath. Of these, some have served the purpose of the priest to delude mankind, while part of the others have been more usefully employed.

Carburetted hydrogen gas is well known to be the "fire-damp" of the coal districts, and to

* From Mr. De la Beche's Geological Manual (third edition, considerably enlarged in 1833), one of the most instructive and entertaining works which the new and important science of geology has yet produced.—ED. M. M.

issue from the coal strata; collecting in the ill-ventilated galleries of collieries, and, when sufficiently mixed with atmospheric air, exploding with great violence when approached incautiously with an unprotected flame, spreading mourning and misery among the families of the miners. If the genius of Davy had merely produced his safety lamp, it would alone have united him to the applause and thanks of mankind.

As carburetted hydrogen is so freely liberated in coal mines, it would be expected that it should occasionally be detected on the surface, and accordingly it has been so discovered.* Inflammable gas also occurs in other situations, where there is no reason to suspect the presence of coal strata. Of this the well-known jets of gas in the limestone and serpentine district of the Pietra Mala, between Bologna and Florence, afford an example.

Captain Beaufort describes an ignited jet of inflammable gas, named the Yanar, near Deliktash, on the coast of Karamania, which perhaps once figured in some religious rites. He states that, "in the inner corner of a ruined building, the wall is undermined so as to leave an aperture of about three feet in diameter, and shaped like the mouth of an oven; from hence the flame issues, giving out an intense heat, yet producing no smoke on the wall." Though the wall was scarcely discolored, small lumps of caked soot were formed in the neck of the opening. The hill is composed of crumbly serpentine and loose blocks of limestone. A short distance down the hill there is another aperture, which, from its appearance, seems once to have given out a similar discharge of gas. The Yanar is supposed to be very ancient, and is possibly the jet described by Pliny.

Colonel Rooke informed Captain Beaufort, that high upon the western mountain at Samos there was an intermittent flame of the same kind; and Major Rennel stated, that a natural jet of inflammable gas, inclosed in a temple at Chittagong, in Bengal, is made use of by the priests, *who even cooked with it.*

According to M Imbert, gaseous exhalations are employed at Thsee-Lieon-Tsing, in China, to distil saline water, obtained from wells in the neighborhood. Bamboo pipes carry the gas from the spring to the place where it is to be consumed. These tubes are terminated by a tube of pipe clay, to prevent their being burnt. A single well (of gas) heats more than three hundred kettles. The fire thus produced is exceedingly brisk, and the caldrons are rendered useless in a few months. Other bamboos conduct the gas intended for lighting the streets and great rooms or kitchens.

M. Klaproth notices other jets of inflammable gas in China; one, now extinguished, is stated to have burnt from the second to the thirteenth century of our era.

It also appears that M. Rœders, inspector of the salt mines of Gottesgabe, at Reine, in the country of Tecklenberg, has for two or three years used an inflammable gas, which issues from these mines not only as a light, but for all the purposes of cookery. He obtains it from the pits that have been abandoned, and conveys it by pipes to his house. From one pit alone a continuous stream of this gas has issued for sixty years. It is supposed to consist of carburetted hydrogen and olefiant gas.

Inflammable gases are also found to proceed from ground charged with petroleum and naphtha. The inhabitants of Baku, a port on the Caspian Sea, are supplied with no other fuel than that derived from the petroleum and naphtha, with which the earth in the neighborhood is strongly impregnated. About ten miles to the north-east of this town there are many old temples of Guebres, in each of which there is a jet of inflammable gas rising from apertures in the earth. The flame is pale and clear, and smells strongly of sulphur. Another and a larger jet issues from the side of a hill. If, in the circumference of two miles, holes be made in the earth, gas immediately issues, and inflames when a torch is applied. The inhabitants place hollow canes into the ground, to convey the gas upwards, when it is employed for the purposes of cookery, as well as for light.

* It appears very remarkable, that in the coal districts of the British isles, where such a large amount of carburetted hydrogen is annually produced, means have not been adopted for making an economical use of this gas, both as it respects light and heat.

The Liverpool and Manchester Railway. [From the London Mechanics' Magazine.]

We have been favored with a copy of the report made by the Directors of this Company, and find in it so much matter of fact that is of universal interest, on the subject of railways and locomotive power, that we need offer no apology for transferring it (with but little abridgment) to our pages. Mr. Grahame, and the other partisans of canal navigation, who still persist, with so much honesty and candor, in representing that the profits of this railway arise mainly from the conveyance of passengers, and that it cannot possibly compete with canals in the conveyance of goods, will observe in this report some rather stubborn facts on both these heads. The common-road steam-carriage charlatans too, who tell us that the expense of working a steam-carriage on a granite highway will be not more than *sixpence per mile*, and the tear and wear *next to nothing* (for "1,700 miles" at least), may learn from the circumstantial details here given of the actual expense of working such carriages on a railway, where the friction is many times less than on the best granite road that can be constructed, how much occasion they have to blush for the delusive representations they have sent forth to the public. We do not of course include in this class of public deceivers any of those honest and intelligent individuals—the Heatons, Hancocks, and Saxulas, of the day—who frankly subscribing to the undeniable fact, that there is more friction to be overcome on a common road than on a railway, have proposed to themselves to determine by experiment whether it would not be cheaper to work steam carriages against that greater friction, than to

be at the expense of laying down railways to avoid it—in some cases at least, if not in all. These last are adventurers of a very different stamp; they speculate on a particular result, which, though as yet unascertained, is neither impossible nor improbable; and as long as they pursue the reasonable object they have in view by honorable means, they shall command as they deserve our best encouragement and support.

LIVERPOOL AND MANCHESTER RAILWAY—FOURTH HALF-YEARLY MEETING.

LIVERPOOL, January 23, 1833.

Report.—The Directors, in submitting to the Proprietors a statement of their accounts and proceedings for the half-year ending 31st December, 1833, have to report a considerable increase in the general business of the concern, as compared with the corresponding six months of the previous year.

The total quantity of merchandise conveyed in the six months between Liverpool and Manchester was	69,806	tons.
To and from different parts of the line, including Warrington and Wigan	9,733	"
Between Liverpool and Manchester and Bolton	18,708	"
Total quantity conveyed	98,247	"
Quantity of coal from various parts to Liverpool	32,304	"
Ditto to Manchester	7,830	"
Total to Liverpool and Manchester.	40,134	"
The number of passengers booked at the Company's offices	215,071	
The number of trips of 30 miles performed by the locomotive engines with passengers was	3,253	
Ditto with merchandise	2,587	
Total	5,840	

Compared with the corresponding six months of the last year, the increase in merchandise conveyed has been 11,405 tons—in passengers, 32,248.

The present winter has been in an extraordinary degree stormy and wet, which has no doubt diminished the amount of travelling.

The wetness of the season also has prevented the railway from being maintained in that complete order which is desirable; while the boisterous weather, with the dirty state of the rails, has impeded the passage of the trains, not unfrequently rendering assistant engines necessary to ensure their progress, even on the level parts of the way. These circumstances have unavoidably increased the charge for locomotive power. On the other hand, the navigation of the river, owing to the long continuance of tempestuous weather, being frequently dangerous, and sometimes impracticable, the utility and importance of the railway conveyance have become more manifest and striking, and the natural consequence has been an accession of traffic to the Company proportioned to the required accommodation afforded to the public.

The following is a statement of the receipts and expenditures for the half-year; and the subjoined table exhibits a detailed classification of the disbursements.

Half-year ending 31st December, 1833.

RECEIPTS.

	£	s.	d.
Coaching department	£54,685	6	11
Merchandise do.	39,957	16	8
Coal do.	2,591	6	6
	£97,234	10	1

EXPENSES.

	£	s.	d.
Advertising Account	£6	10	0
Bad debt do.	374	10	1
Coach disbursement do., viz., guards and porters' wages, 1,168*l.* 4*s.* 6*d.*; parcel carts, horsekeep and drivers' wages, 361*l.* 1*s.* 7*d.*; materials for repairs, 689*l.* 12*s.* 6*d.*; men's wages repairing, 1,041*l.* 1*s.* 3*d.*; gas, oil, tallow, cordage, &c., 196*l.* 4*s.* 11*d.*; duty on passengers, 3,224*l.* 11*s.* 11*d.*; stationary and petty expenses, 277*l.* 4*s.* 5*d.*; taxes on offices, stations, &c., 116*l.* 0*s.* 8*d.*; guards' clothes, 64*l.* 15*s.*	7,138	16	9
Carrying disbursement account, viz., agents and clerks' salaries, 1,728*l.* 16*s.* 9*d.*; porters and brakesmen's wages, horsekeep, &c. 5,006*l.* 6*s.* 10*d.*; gas, oil, tallow, cordage, &c., 529*l.* 17*s.*; repairs to jiggers, trucks, stations, &c., 366*l.* 9*s.* 11*d.*; stationary and petty expenses, 429*l.* 5*s.* 1*d.*; taxes and insurances on offices, &c., 456*l.* 17*s.* 7*d.*; sacks for grain, 110*l.* 3*s.* 10*d.*	8,627	17	0
Coal disbursement account	82	0	9
Cartage (Manchester) do.	3,173	18	0
Charge for direction do.	312	18	0
Compensation (coaching) do	142	4	8
do. (carrying) do	223	10	11
Coach office establishment do. viz., agents and clerks' salaries, 302*l.* 6*s.* 8*d.*; rent, 30*l.*	632	6	8
Engineering department account	319	3	4
Interest do.	5,140	6	4
Locomotive power do. viz., coke and carting, 3,197*l.* 4*s.* 4*d.*; wages to coke fillers and waterers, 348*l.* 8*s.* 5*d.*; gas, oil, tallow, hemp, cordage, &c. 865*l.* 14*s.* 9*d.*; brass and copper, iron, timber, &c. for repairs, 3,755*l.* 3*s.* 7*d.*; men's wages repairing, 4,401*l.* 4*s.* 10*d.*; engine and firemen's wages, 784*l.* 8*s.* 5*d.*; out-door repairs to engines, 613*l.* 3*s.* 9*d.*	13,965	8	1
Maintenance of way account, viz., wages to plate layers, joiners, &c., 2,937*l.* 19*s.* 2*d.*; stone, blocks, sleepers, keys, chairs, &c., 2,411*l.* 2*s.* 4*d.*; ballasting and draining, 925*l.* 16*s.* 11*d.*; new rails, 150*l.* 16*s.* 3*d.*	6,425	14	8
Office establishment account, viz., salaries, 607*l.* 2*s.*; rent and taxes, 75*l.* 14*s.* 3*d.*; stationary and printing, 22*l.* 7*s.* 8*d*; stamps, 17*l.* 2*s.* 3*d.*	722	6	2
Police account	1,022	7	6
Petty disbursement do	61	19	6
Rent do	603	10	8
Repairs to walls and fences	665	3	4
Stationary engine and tunnel disbursement account, viz., coal, 302*l.* 6*s.* 5*d.*; engine and brakesmen's wages, 319*l.* 11*s.* 2*d.*; repairs, gas, oil, tallow, &c., 419*l.* 15*s.* 5*d.*; new rope for tunnel, 266*l.* 3*s.* 6*d.*	1,309	16	6
Tax and rate account	3,409	11	0
Waggon disbursement do.. viz., smiths and joiners' wages, 718*l.* 19*s.* 7*d.*; iron timber, castings, &c., 700*l.* 9*s.* 1*d.*; cordage, paint, &c., 28*l.* 5*s.* 2*d.*; canvass for sheets, 163*l.* 6*s.* 5*d.*	1,611	0	3
Cartage (Liverpool)	80	17	10
Law disbursement	390	3	0
	£56,350	1	9

RECAPITULATION.

	£	s.	d.
Receipts	£97,234	10	1
Expenses	56,350	1	9
Net profits for six months	£40,884	8	4

1st July to 31st December, 1833.

DISBURSEMENTS APPORTIONED UNDER THE DIFFERENT HEADS OF EXPENDITURE.

	Per Passenger Booked.	Per Ton of Merchandise Liverpool and Manchester.	Per Ton of Coal.	Per Ton on Bolton Tonnage.	Coaching Department.	Merchandise Department.	Coal Department.	Bolton Tonnage.	TOTALS.
	s. d.	s. d.	s. d.	s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
Disbursements in the merchandise department, consisting of porterage, salaries, parish rates, and insurance, £456 17*s.* 7*d.*, carting, stationary engine, &c. disbursements..................	......	3 9¾	......	0 3¼	....	15,150 9 11	....	249 0 8	15,399 10 7
Disbursements in the coaching department, comprising porterage, salaries, repairs, duty on passengers, £3,224 11*s.* 11*d.*, &c. &c.	0 9	....	......	......	7,913 8 1	....	....	....	7,913 8 1
Porterage, &c. in the coal department, after deducting amount received for weighing coal.....	......	....	0 0½	......	....	....	82 0 9	....	82 0 9¼
Locomotive power account, proportioned according to the number of trips of 30 miles in each department, comprising repairs of engines, wages, coke, &c. &c.	0 8¾	1 6½	......	......	7,779 0 1	6,186 8 0	....	....	13,965 8 1
Sundry disbursements, proportioned according to the receipts as between the coaching and merchandise departments, and according to the number of tons and miles conveyed, as between the Liverpool and Manchester and Bolton trade, comprising maintenance of way, police, and gate establishment, general office establishment, &c. &c.....	0 6¼	0 10½	0 1½	0 7	5,532 0 2	3,494 5 1	262 2 10	547 18 2	9,836 6 3
Rates and taxes, interest on loans, and chief rents, proportioned according to the amount of profit in each department, calculated *exclusively* of these items of disbursement.	0 6¾	0 7¾	0 2½	0 1¼	6,120 19 11	2,526 6 3	411 1 5	95 0 5	9,153 8 11
Total disbursements........	2 6¾	6 10½	0 4½	0 11½	27,345 8 3	27,357 9 3	755 5 0	891 19 3	56,350 1 9
Net profit.................	2 6½	2 10	0 11	0 5¼	27,339 18 8	11,283 19 7	1,836 1 6	424 8 7	40,884 8 4
Gross receipts..............	5 1¼	9 8½	1 3½	1 4¾	54,685 6 11	38,641 8 10	2,591 6 6	1,316 7 10	97,234 10 1

Statement of Receipts and Expenditures on Capital Account, from the commencement of the undertaking to 31*st December*, 1833.

TREASURER, DR.

	£	s.	d.
To amount of joint capital in shares and loans..................................	£1,086,885	0	0
.. Ditto of dividends not paid.........	1,087	3	1
.. Surplus in hand after payment of the sixth dividend, in August, 1833......	395	10	2
.. Net profits of the concern for the half year ending 31st December, 1833....	40,884	8	4
	£1,129,252	1	7

TREASURER, CR.

	£	s.	d.
By amount of expenditure on the construction of the way and the works, including the tunnel, excavations, &c. now in progress........................	1,089,818	17	7
.. Ditto in the hands of Moss & Co., bankers..................................	28,476	11	9
.. Ditto in the hands of the treasurer..	242	15	9
.. Ditto of arrears on calls...........	25	3	6
.. Ditto balance of book debts due to the company........................	10,688	12	0
	£1,129,252	1	7

During the past six months the excavation of the new tunnel from the vicinity of Waver-street lane to Lime-street has proceeded regularly and satisfactorily, and is now more than half completed.

In order to extend the advantages of a railway conveyance to the northern docks, and those parts of the town which are at a considerable distance from the railway station, the Directors transmitted a memorial to the Common Council, the Dock Committee, and the Commissioners of Sewers, proposing to construct, at the expense of the Company, a line of railway from Wapping to the Clarence Dock, by means of which merchandise deposited at the north end of the port might possess the same facilities of conveyance by railway into the interior of the country as goods in the southern portion of the town, besides relieving the streets from the noise and interruption of numerous waterside carts. This memorial, as might be expected, from the evident utility of the scheme, has been favorably received, especially by the Dock Committee, and the Commissioners of Sewers; the principal objection to the plan being that it was not sufficiently general and extensive to afford to the public at large that measure of accommodation which appeared so easily practicable. The Directors, however, confidently look forward to the establishment on a comprehensive plan, probably to be undertaken by the Dock Trustees, of a line of railway, with the requisite branches, along the dock quays from the northern to the southern extremities of the port; which mea-

sure seems alone wanting to give to the mercantile public those advantages of economy and despatch which a railway conveyance is so peculiarly calculated to afford.

The proprietors are aware that the subject of locomotive engines has always been one of great interest and importance. The charge under this head continues very heavy, arising in a great measure from the necessity of renewing and strengthening the frame work of the machinery; and from the purchase of copper and brass plates for the renewal of fire boxes and tubes.

The charge for coke has been a heavy item in the locomotive expenditure, amounting to nearly £6,000 per annum. The directors have lately been induced to try gas coke to a very considerable extent. The cost per ton is less than one-half the cost of Worsley coke; and although a greater weight is required to do the same service, and an extra consumption of fire bars and some other difficulties attend the use of it, the Directors have considered the experiment well worth making, in the hope of diminishing the expenditure in that department.

Several new schemes for an improved locomotive power have lately been brought under the consideration of the Directors. Past experience forbids any very sanguine anticipations of success in respect of untried speculations; at the same time, the Directors will not fail impartially to investigate the pretensions of any scheme from a respectable source, which professes to introduce improvement into so important a branch of the Company's establishment.

The charge for the maintenance of the way is another heavy item of the current expenditure. In particular parts of the road, especially on the descending lines of the inclined planes, the rails prove too weak for the heavy engines, and the great speed at which they are moved; and from the breakages which have taken place, the Directors have thought it expedient to order a supply of stronger and heavier rails, to put down in those districts where the present rails have been found insufficient. This proceeding will in the first instance subject the Company to some increased expenditure. The Directors, however, have contracted (for the ensuing year) for that portion of the maintenance of way which consists of labor and small materials on terms of comparative advantage to the Company, which they expect will balance the increased outlay required for the purchase of stronger rails.

The Iron Steamboat Alburkha.—This vessel is now in the river Niger, with the Quorra steamboat, and seems to have been the favorite of the two vessels since they departed on their interesting expedition. The advantages of iron vessels in warm climates are ably pointed out in a short extract we gave in our last number from Chambers' Journal; and these advantages seem in no wise exaggerated in the instance of the Alburkha, according to reports received from those embarked in her. This vessel was built by Mr. Laird, of Liverpool, for the purpose of navigating the shoal water of the river, and we understand that he has since constructed another for the interior navigation of Ireland. We have no doubt that these vessels, from their vast superiority over those of wood, and their durable quality, will speedily be numerously employed.—[Nautical Magazine.]

Burden's Boat.—The "London Mechanics' Magazine" having copied our engravings of this boat, and also partially the description, from one number of the Railroad Journal, remarks that, comparing the perspective view with fig. 3, "it cannot be a very correct representation of the actual appearance of the vessel; the two trunks do not project so absolutely apart, like two horns, as here shown." If the editor of that work will peruse the description given in this Magazine, he will find that the guard intended to be outside was not there when the trial was made, and that it has been pronounced correct in every particular by the inventor. As a further proof of its correctness, it has been copied in at least 12 periodicals in this country as an authentic account. The editor also states that the boat was built at New-York. He is in error in so asserting: it was constructed at Troy, so far as it appears represented in those engragings. It is now at the Dry Dock in this city, being finished; and we intend, with the assistance of Mr. Burden, and other eminent engineers, to give a full representation of it very soon, with such explanations and references as are necessary; and, on its first trip, to record every particular of interest to our readers.

Salt.—The people of Onondaga county, N. Y., believe that they have under them an inexhaustible mass of rock salt, and that in raising this, instead of brine, they shall save half the expense of manufacturing, and be able to supply the Atlantic towns with salt cheaper than they can import it. There is one difficulty which now threatens, and that is the expense of fuel. The wood now used at the different salt springs now in operation amounts to 400 cords a day, and as the works are in use 200 days in a year, the annual consumption is 80,000 cords.

The *Mechanics' Magazine and Register of Inventions and Improvements* is published by the Proprietors, D. K. Minor and J. E. Challis, at No. 35 Wall street, New-York: in *weekly* sheets of 16 pages, at 6¼ cents—in monthly parts of 64 pages, at 31¼ cents—in volumes of 384 pages, in cloth boards, at $1.75—or at $3 per annum *in advance*.—John Knight, (formerly proprietor of the London Mechanics' Magazine,) Editor.